

Methane Cleansing By Microbial Removal of H₂S

Field of the Invention

[0001] This invention relates generally to biofiltration, and more specifically to a system for the removal of hydrogen sulfide (H₂S) from gaseous fuels such as methane..

Background of the Invention

[0002] In the biofiltration industry typical problems which are focused on include odor control, VOC removal, and the treatment of petroleum hydrocarbons. A fourth problem which has yet to be successfully addressed in the field of biofiltration is the removal of noxious and deleterious sulfur from energy gases.

[0003] Organic material can be microbially digested in the absence of oxygen to form biogas containing mostly methane, carbon dioxide, and small amounts of hydrogen sulfide. Specific systems have been developed which allow dairy farmers to collect animal waste and turn it into biogas, which can then be used to generate useful heat and electricity.

[0004] These systems have been researched since the early 1970's but economic and operational barriers have curtailed their widespread implementation. Recent emphasis on environmental protection, renewable fuel sources, and distributed generation indicates that these systems will likely become more prevalent.

[0005] When methane containing H₂S is used as a fuel, such as to run a motor-generator, the combustion converts the H₂S to harmful sulfuric acid (H₂SO₄) which corrodes the generator and dramatically shortens the generator lifetime.

[0006] It can therefore be seen that there is a need in the field for a system which will reduce and/or eliminate H₂S from methane to provide a "cleaner" methane for use as a fuel.

Summary of the Invention

[0007] It is therefore an object of the present invention to overcome the problems of the prior art described above.

[0008] It is another object of the present invention to provide a method of H₂S removal from fuel gases.

[0009] It is another object of the present invention to provide a method of H₂S removal from organic gaseous fuel.

[0010] It is another object of the present invention to provide a method of H₂S removal from methane.

[0011] It is yet another object of the present invention to provide a biofiltration system for the removal of H₂S from fuel gases.

[0012] It is a further object of the present invention to provide a system for H₂S removal from fuel gases which utilizes a reactor cartridge.

[0013] The invention is directed to a system for removing H₂S from methane (CH₄) or other suitable gaseous fuel which includes providing at least one biofilter cartridge which sustains microbial activity that will function to consume H₂S contained in a stream of methane gas. In one embodiment, a stream of methane gas which contains H₂S is transported directly into a biofilter system which contains at least one cartridge containing selected microorganisms which function to biodegrade H₂S. The clean methane gas is then recirculated to a source of use.

[0014] A suitable reactor cartridge which can be used in the present invention includes an outer housing having a pair of oppositely disposed open ends. The housing which contains an inlet fan and an inlet port connected to a vertical inlet tube positioned at one end which also contains a water inlet and a gas outlet. A water reservoir is attached to the opposite end of the housing, with the reservoir further containing an outlet for the removal of water. In operation, a source of methane which contains H₂S to be treated is passed through the inlet and down the vertical tube and reverses direction at the bottom to go up through a suitable source of microorganisms contained in said housing which are selected to degrade the H₂S.

The treated methane is released through said gas outlet, at the top of the housing and captured for storage or direct use.

Brief Description of the Drawings

[0015] For a further understanding of these and objects of the invention, reference will be made to the following detailed description of the invention which is to be read in connection with the accompanying drawing, wherein:

[0016] FIG. 1 is a side elevational view of a reactor cartridge used in the present invention having upward airflow.

[0017] FIG. 2 is a partial sectional view of the cartridge of Fig. 1 with the bottom of the cartridge disassembled.

[0018] FIG. 3 is a partial sectional view of the cartridge of Fig. 2 with the bottom assembled illustrating the down flow of the gas being treated opposite to Fig. 1.

[0019] FIG. 4 is a partial section view of the cartridge of Fig. 3 in which the inlet tube has been deleted.

Detailed Description of the Invention

[0020] In the present invention aerobic microorganisms are used to remove hydrogen sulfide from the gas stream and oxidize it back to sulfate, which then combines with water to form sulfuric acid.

[0021] Initial testing indicated that cow manure compost, which contains sulfur oxidizing bacteria, can remove hydrogens sulfide (H₂S) from a gas stream with removal efficiencies above 80%.

[0022] Farm digester gas is not the only source of sulfide contaminated methane rich gas for which biofiltration technology may be suitable. Wastewater treatment plants, landfills, paper mills, and food processing plants are all capable of producing biogas. Additionally, as higher quality natural gas wells are depleted, it may become economical to exploit smaller, remote, sulfur contaminated wells,

biofiltration with its modular nature and low operating costs may be the ideal technology for sulfur removal from these gas source.

[0023] One embodiment exemplary of the invention is illustrated in Figs. 1-3 is directed to a system for removing hydrogen sulfide (H_2S) from methane (CH_4) or other suitable gaseous fuel. As shown in Figs. 1-3 at least one biofilter cartridge 10 which sustains microbial activity can be used to consume H_2S contained in a stream of methane gas 19 that is introduced to the microorganisms at the top or bottom of the carrier media 11. As shown by the arrows in the drawings, a stream of methane gas which contains H_2S is transported directly into a biofilter system which contains at least one cartridge containing selected microorganisms which function to biodegrade H_2S . The clean methane gas 26 is then recirculated to a source of use.

[0024] Carrier 11 may comprise any artificial or synthetic such as granular inert plastics, ceramics or crystalline materials which support and act as a carrier for the microorganisms or bacteria. Pearlite functions as an economical and readily available carrier or media. Any suitable microorganism or bacteria which functions to remove or biodegrade H_2S can be used. Suitable microorganism include *Thiobacillus* and *Ralstonia*. If a natural occurring or biodegradable material is used in place of a synthetic carrier, such as cow manure compost, tree bark or vegetation, then microorganisms indigenous to these materials will function to biodegrade the H_2S .

[0025] A suitable reactor cartridge 10 which can be used in the present invention includes an outer housing 12 having a pair of oppositely disposed open ends which are closed by a bottom 14 and a top 16. The housing contains an inlet fan or blower 18 and an inlet port 20 connected to a vertical inlet tube 22 positioned at one end which also contains a flush water inlet 24 and a gas outlet 26. A water reservoir 28 is contained in bottom member 14 at the opposite end of the housing, with the reservoir further containing an outlet 30 for the removal of flush water. In operation, a source of methane 19 which contains H_2S to be treated is passed through the inlet and down the vertical tube 22 and reverses direction at the bottom to go up through a suitable source of microorganisms contained in said housing which are

selected to degrade the H_2S . The treated methane is released through said gas outlet, at the top of the housing and captured for storage or direct use. The remote cartridge is also flushed by the down flow of water 25.

[0026] Fig. 4 illustrates an alternative embodiment of the present invention in which inlet tube 22 has been removed, and the methane flow 19 is from the bottom upward through carrier 11.

[0027] While the present invention has been particularly shown and described with reference to the preferred mode as illustrated in the drawing, it will be understood by one skilled in the art that various changes in detail may be effected therein without departing from the spirit and scope of the invention as defined by the claims including applications and use for cleansing other gaseous fuels of unwanted secondary organic contaminants.